EM375 Project
DELIVERABLES FOR THE PRELIMINARY FIRING CURVES

The following is a summary of what is to be submitted as the *"Preliminary Firing Curves"*. One submission per group. Although this submission is "preliminary," your work should be as close to "final" as you can make it. Credit will be assigned for numerical accuracy as well as the style and quality of presentation.

SUBMIT the FOUR PLOTS identified on the next page. There is to be one plot per page (full page) with properly labeled axes and units. Axes are to be scaled to fit the data and grid lines are to be printed to allow for easy use in the field.

FOR EACH PLOT, ALSO SUBMIT a separate page (one per plot) showing one representative calculation. You should present this calculation using a Mathcad worksheet formatted as an enclosure.

SUBMIT A TABLE of the actual numbers and units you used for the following:

Balloon diameter
Balloon mass
Pouch mass
Mass of one 6-ft section of large tube
Cross sectional area of large tube
Strain hardening material constants
Air density.

If any of the above numbers are derived (e.g. mass derived from measured weight, or balloon diameter from circumference) you must include both the measured quantity and show how you converted it to the required quantity.

The plots that make up the firing solution are:

Plot 1: Impact distance vs. Launch speed for **three** different launch angles. Your launch angles must be in the range 10 to 40^{O}, in increments of 5^{O}. The minimum range will be 100ft and the maximum will be 200ft.

Plot 2: Launch speed vs. stretch ratio for values of l from 1.0 to 3.0. Make sure your Mathcad worksheet includes your calculated launcher efficiency, h.

Plot 3: Flight time vs. launch speed for the same three launch angles.

Plot 4: Lateral shift vs. flight time for cross wind speeds of 5, 10 and 15 mph.

On field day you will use Plot 1 and your chosen launch angle to determine the required launch speed. Using this launch speed and Plot 2, you will determine what stretch ratio to apply to the tubing on the launcher.

Plots 3 and 4 will be used if there is a crosswind on launch day. Unlike normal military operations, the target will cooperate by moving left or right of centerline, as dictated by your graphs!

Headwind/tailwind adjustment. Headwind can be taken into account by varying the differential equations to include the increased (or reduced for tailwind) drag force. We did not do this during the project. Rather, you ignored headwind in your calculations.

Providing the headwind/tailwind does not exceed about 15ft/s (10 mph), we can use an approximate adjustment that has been determined for this particular launcher and project configuration.

> For the minimum range (100ft), increase your launch speed (ft/s) by the (headwind / 5)
>
> For the maximum range of 200 ft, increase your launch speed (ft/s) by the (headwind / 2.5)
>
> For a tailwind, *reduce* your launch speed by the same values as indicated above.